# ICTHYOFAUNAL CONTRIBUTION TO THE STATE AND COMPARISON OF HABITAT CONTIGUITY ON TAXONOMIC DIVERSITY IN SENKHI STREAM, ARUNACHAL PRADESH, INDIA[1]

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[1]Accepted March 2007
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The Eastern Himalayan region has been identified as one of the 18 mega-biodiversity 'hotspot' areas of the world (Myers *et al.* 2000). Arunachal Pradesh constitutes 60.93% of the Eastern Himalayan region. Some documentation exists on the flora, but documentations on faunal aspects are still scanty, with scattered reports, mostly on birds and some large mammals. Although contributions to the fish fauna of the State have also been made, accounts of species compositions of many water bodies still remain undocumented awaiting explorations and studies of such aquatic systems. Descriptions of most faunal works have been added with special emphasis on fishes. The preliminary findings suggest 7 first reports for the district and 3 first reports for the State. Senkhi stream contributed 31.37% of the icthyofaunal families of the district and 29.52% of genera while the species representation was found to be 27.32%. The correlation matrix reveals an interesting fact that Dikrong and Pachin have more common species than Senkhi, which is a hill stream. The striking feature is the even distribution of species under family Badidae, Psilorhynchidae and Olyridae though their contribution of each lotic (Senkhi, Pachin and Dikrong) water body is merely a single species and hence these species will be most vulnerable once a mega dam comes in-between, restricting the migration of already threatened population.

**Keywords:** Eastern Himalaya, Arunachal Pradesh, Lotic, Icthyofauna

## INTRODUCTION

Myers *et al.* (2000) identified 18 mega-biodiversity 'hotspot' regions of the world, based on the criterion of exceptional concentration of species and endemism as well as exceptional degrees of threat arising out of increased pressures of human intervention, with the possibility of potential extinction of constituent species caused by the latter. Myers *et al.* (2000) predicted the possibility of a major extinction spasm impending in these areas. However, they also pointed out that if key localities of biotic richness can be identified, conservation priorities could be determined in a more informed and methodological manner than has been the case (Mittermeier *et al.* 1999 and Myers *et al.* 2000). The principal drawback, however, has been the lack of basic data, especially of animal species.

Out of the 18 'hotspots' the Eastern Himalayan region was assessed to have an 'ultra-varied' topography, a factor thought to be the working principle which fosters species diversity and endemism. However the lack of data, particularly of species number and distribution, seems especially acute for this region with large parts remaining unexplored scientifically.

The state of Arunachal Pradesh, stretching from 26° 30' to 29° 30' N and 91° 30' to 97° 30' E, falls within the Eastern Himalayan region. In fact, Arunachal Pradesh, with a total geographical area of 83,743 sq. km, constitutes a substantial proportion of this mega-biodiversity 'hotspot' region. It is known for its topographic and altitudinal diversity, its rich forests and numerous riverine bodies. Among the constituents of the Eastern Himalayan Hotspot region (Nepal, Bhutan and Yunnan in China), Arunachal Pradesh probably still retains the highest forest cover. Given the low density of human population and difficult terrain, many of its forests and rivers remain pristine and undisturbed. Inaccessibility, arising out of the attributes of topography and climate, has helped to conserve the natural resources of the State, but this has also meant that the rich biological resources of the State remain largely undocumented.

In context of Arunachal Pradesh, the efforts made by governments (both State and Central) for the development of the state and its populace has been relatively slow as compared to other parts of country. There is urgency for extensive studies on biodiversity related issues keeping in mind the immense bioresources of Arunachal Pradesh. One of the immediate visible signs of development efforts in Itanagar, the capital, is the rapid urbanization and spread of settlements which have adverse effects on the flora and fauna of a given location. Apart from the local extinction of biological elements consequent to permanent changes of land use, urbanization also has its deleterious impact on the water bodies. The disposal of urban waste into water bodies, removal of sand, boulders and stones change the micro-habitats of the stream and bring about a consequent depletion of species inhabiting such systems. Arunachal's network of riverine systems offers tremendous potential for hydro-power generation. Each hydro-power project involves the construction of major dams. The impact of such major changes on the resident biological elements is well known and contributes to the depletion of biodiversity. It is imperative, therefore, to carry out extensive documentations so that baseline data and information are generated, thereby contributing to conservation strategies and prioritization of ecological (and evolutionary) sensitive locations.

So far as icthyofauna is concerned, the earliest report seems to be of McClelland (1839) who mentioned four species from Lohit (Mishmi hills) in his account of Indian Cyprinids. This is followed by Chaudhuri (1913) who reported 21 species from the State. Hora (1921), Jayaram (1963), Jayaram and Mazumdar (1964), Srivastava (1966), Dutta and Sen (1977), Dutta and Barman (1984, 1985), Sen (1985), Sen (1999), and Nath and Dey (2000) are the other workers who have contributed to the fish fauna of the State. The reports of the above workers are accounts from different parts of Arunachal Pradesh and cover West Kameng, Upper and Lower Subansiri, East and West Siang, Lohit, Tirap and Changlang districts of Arunachal Pradesh. While reports on the icthyofauna seems to cover the State fairly well, gaps remain in regard to a complete coverage of a given drainage system and the reports do not give accounts of seasonal variations of the fish fauna from a given location. While surveys can provide an indication of species diversity of the given location at a given time, they fail to provide an indication of seasonal fluxes and hence, fail to record species with seasonal immigration into the system. The present investigation was conducted in Senkhi stream, a lotic system that drains into the Brahmaputra through the Pachin and Dikrong rivers. Regular monitoring of species diversity and richness has been initiated from September 14, 2004 and the present report is a compilation based on the thirteen months monitoring.

## METHODOLOGY

Weekly samples were collected from three permanent sites on the Senkhi stream, using a cast net of 0.007 m mesh size and radius of 2.29 m. Samplings were done after dusk (from 1800 to 2200 hrs, except for one occasion, when sampling was carried out between 0100 and 0400 hrs). To supplement the above efforts, regular sampling was also done on a 5 km stretch in order to assess the species diversity found in catches from the study sites. It may be worth mentioning that the 5 km stretch was abandoned after 52 weeks of sampling and hence was termed as non regular, while the study was continued in the regular sampling sites till November 14, 2005. The species diversity reported here includes all the samplings outlined. Taxonomic identification used here follows those reported by Jayaram (1999). Representatives have been preserved and deposited in the NE Unit's office and this is supplemented with photographic documentation of each species, taken on the day of the catch. Senkhi, Dikrong and Pachin are contiguous water bodies (Fig. 1), there is no barrier for migration of fishes from each water body to other. Assuming that all fishes have equal chances of migration to and fro from all the three water bodies, the taxonomical enumeration of fishes of all the three water bodies can be used to find effect of contiguity on taxonomic diversity. Senkhi form the uppermost part of the water body and was sampled by us; however at mid elevations Pachin and lower plain river Dikrong was sampled by Nath and Dey 2000. Therefore, present enumeration of fishes was subjected to comparison with that of Nath and Dey 2000 to asses the effect of habitat contiguity on taxonomic distribution of fishes. The species were compared for their correlation matrix in all three lotic water bodies using Statsoft 2001, also their higher taxa appropriation was calculated corresponding to each lotic water body.

## RESULTS

The icthyofaunal diversity of the study site is restricted to 47 species belonging to 31 genera, spread over 16 families (Table 1). The species diversity listed is the cumulative total of fifty two regular samplings spread over a time period of thirteen months beginning September 14, 2004. The frequency of occurrence of each species was calculated based on the number of occasions the species was collected during the samplings. The results presented in Table 1, suggest that of the 47 species collected, 3 species belonging to the families Cyprinidae, Cobitidae and Psilorhynchidae were common in the study sites. The analysis also indicates that 9 more species, belonging to Cyprinidae, Sisoridae, Channidae, Bagridae, and Cichlidae, are rare. Of these, three species – *Glyptothorax telchitta*, *Labeo gonius*, and *Oreochromis mossambica* – are extremely rare, having been collected only once during the whole study period. It is important to note, however, that the occurrence of *Oreochromis mossambica* in the lotic system may be accidental and a result of introduction through flood waters from fishery ponds nearby where they occur as a common culture fishery species. Thus, although

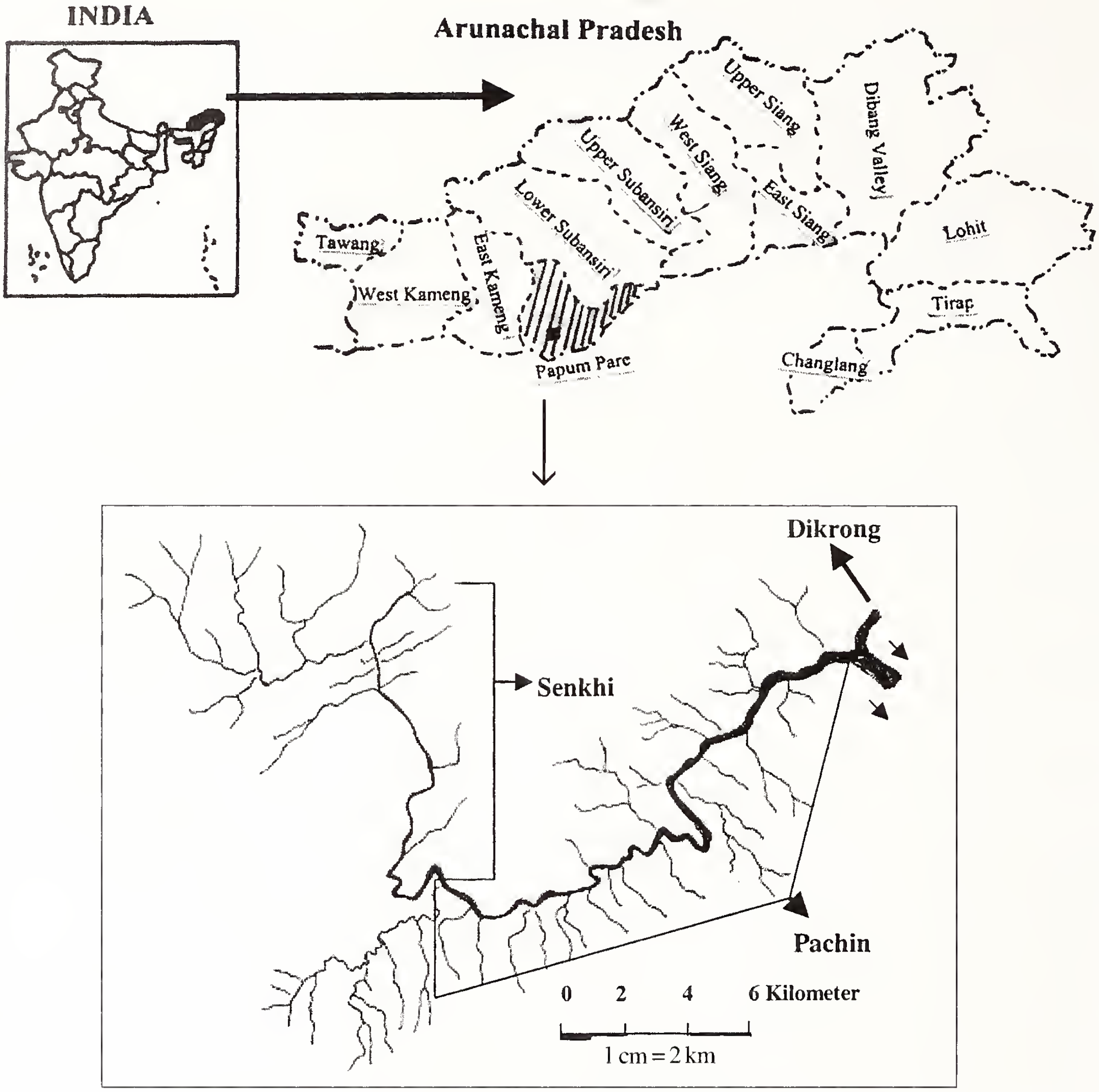


Fig. 1: Map of Itanagar, Papum Pare districts, showing Senkhi, Pachin and Dikrong

the species is included in all the assessments reported subsequently, it must be considered as an accidental migrant not normally native to such systems.

An analysis of the taxonomic composition of the fish fauna suggests Cyprinidae to be the most dominant family with 22 representative species (43%) occurring in the study site. Cobitidae, the next dominant family, has 6 species inhabiting the site (17%), followed by Sisoridae with 3 representative species (10%). Whereas Amblycepitidae, Psilorhynchidae, Homalopteridae, Heteropneustidae, Chandidae, Channidae, Clariidae, Cichlidae, Olyridae, Badidae, Erethistidae and Bagridae are the other 12 families each having single species representation.

In addition to the 47 species reported above, another 11 species belonging to 8 genera, spread over 6 families were also caught during the single survey of a 5 km stretch downstream from the study site. The species caught during this survey are listed in Table 1. The taxonomic diversity in this catch shows a co-dominance of the families Cyprinidae and Cobitidae, with 7 species representation (70%). Cobitidae, Clariidae and Mastacembelidae with 1 species each (30%) follow next.

The higher taxa diversity, on combining of the results of the two sample sets, shows an interesting transformation. While Family Cyprinidae with 22 species (48%) retains its predominance, Cobitidae follows as a poor second with

**Table 1**: Fish catch frequency corresponding to their status in the Senkhi stream, Papum Pare

| Sl.No | Scientific name | Catch frequency (%) | Status |
|---|---|---|---|
| 1 | *Barilius bendelisis* Hamilton | 100 | Common |
| 2 | *Aborichthys elongatus* Hora | 92.3 | Common |
| 3 | *Psilorhynchus balitora* Hamilton | 92.3 | Common |
| 4 | *Tor tor* Hamilton | 88.5 | Abundant |
| 5 | *Garra gotyla gotyla* Gray | 80.8 | Abundant |
| 6 | *Garra annandalei* Hora | 78.8 | Frequent |
| 7 | *Acrossocheilus hexagonolepis* McClelland | 71.2 | Frequent |
| 8 | *Schistura devdevi* Hora | 67.3 | Frequent |
| 9 | *Botia rostrata* Gunther | 65.4 | Frequent |
| 10 | *Barilius tileo* Hamilton | 51.9 | Occasional |
| 11 | *Semiplotus semiplotus* McClelland | 48.1 | Occasional |
| 12 | *Danio aequipinnatus* McClelland | 40.4 | Occasional |
| 13 | *Crossocheilus latius latius* Hamilton | 36.5 | Occasional |
| 14 | *Hara hara* (Hamilton) | 36.5 | Occasional |
| 15 | *Glyptothorax pectinopterus* Menon ● | 34.6 | Occasional |
| 16 | *Chagunius chagunio* Hamilton | 34.6 | Occasional |
| 17 | *Balitora brucei* Gray † | 32.7 | Occasional |
| 18 | *Botia dario* (Hamilton) | 30.8 | Occasional |
| 19 | *Puntius conchonius* Hamilton | 25 | Occasional |
| 20 | *Barilius barna* (Hamilton) | 25 | Sporadic |
| 21 | *Danio dangila* (Hamilton) * | 23.1 | Sporadic |
| 22 | *Acanthocobitis botia*(Hamilton) | 15.4 | Sporadic |
| 23 | *Danio devario* (Hamilton) * | 15.4 | Sporadic |
| 24 | *Glyptothorax brevipinnis* Hora ● | 11.5 | Sporadic |
| 25 | *Heteropneustes fossilis* (Bloch) | 9.6 | Rare |
| 26 | *Puntius sophore* (Hamilton) * | 9.6 | Rare |
| 27 | *Puntius ticto* Hamilton | 7.7 | Rare |
| 28 | *Lepidocephalus guntea* (Hamilton) * | 7.7 | Rare |
| 29 | *Channa orientalis* (Schneider) | 5.8 | Rare |
| 30 | *Oreichthys cosuatis* Hamilton ● | 5.8 | Rare |
| 31 | *Barilius bola* (Hamilton) | 5.8 | Rare |
| 32 | *Puntius chola* (Hamilton) | 5.8 | Rare |
| 33 | *Parambassis ranga* Hamilton* | 5.8 | Rare |
| 34 | *Aspidoparia jay* (Hamilton) | 3.8 | Extremely rare |
| 35 | *Olyra longicaudata* (McClelland) * | 3.8 | Extremely rare |
| 36 | *Amblyceps arunachalensis* Nath & Dey | 3.8 | Extremely rare |
| 37 | *Chanda nama* (Hamilton) * | 3.8 | Extremely rare |
| 38 | *Clarias batrachus* (Linnaeus) * | 3.8 | Extremely rare |
| 39 | *Labeo gonius* Hamilton ● | 1.9 | Extremely rare |
| 40 | *Mystus montanus* Jerdon | 1.9 | Extremely rare |
| 41 | *Oreochromis mossambica* Gray † ● | 1.9 | Extremely rare |
| 42 | *Glyptothorax telchitta* Hamilton † ● | 1.9 | Extremely rare |
| 43 | *Mastacembelus armatus* (Lecepede) * | 1.9 | Extremely rare |
| 44 | *Badis badis* (Hamilton) | 1.9 | Extremely rare |
| 45 | *Glyptothorax cavia* (Hamilton) ● | 1.9 | Extremely rare |
| 46 | *Brachydanio rerio* (Hamilton) * | 1.9 | Extremely rare |
| 47 | *Labeo dero* (Heckel) * | 1.9 | Extremely rare |

Catch frequency with-Common: 91-100%, Abundant: 81-90%, Frequent: 61-80%, Occasional: 31-59%, Sporadic: 15-30%, Rare: 05-14%, Extremely rare: <05%, *: represents the species caught outside the regular sampling site; †: represents the first report for the state; ●: represents first report for the district

6 representative species, contributing 13% to the species composition. The Family Sisoridae, with 4 species, contributes 9% to the icthyofaunal diversity, followed by Mastacembelidae and Chandidae with 2 species at 4% contribution each. Families Amblycipitidae, Badidae, Bagridae, Channidae, Cichlidae, Clariidae, Sisoridae, Heteropneustidae, Homalopteridae, Olyridae, and Psilorhynchidae, were each represented by a single species, thereby contributing a mere 2% to the higher taxa diversity of the lotic system (Table 3). An interesting aspect of the composition is the restrictive

**Table 2**: Comparison of Icthyofauna of three lotic bodies in the Papum Pare district

| Species | Family | Dikrong | Pachin | Senkhi |
|---|---|---|---|---|
| *Aboricthys elongatus* Hora | Cobitidae | + | + | + |
| *Aboricthys kempi* Chaudhuri | Cobitidae | + | + | - |
| *Acanthocobitis botia* (Hamilton) | Cobitidae | + | + | + |
| *Acrossocheilus hexagonolepis* (McClelland) | Cyprinidae | + | + | + |
| *Amblyceps apangi* Nath & Dey | Amblycipitidae | + | - | - |
| *Amblyceps arunachalensis* Nath & Dey | Amblycipitidae | + | - | + |
| *Amblyceps mangois* (Hamilton) | Amblycipitidae | + | + | - |
| *Amblypharyngodon mola* (Hamilton) | Cyprinidae | + | - | - |
| *Anabas testudineus* Bloch | Anabantidae | + | - | - |
| *Anguilla bengalensis* (Gray & Hardwicke) | Anguillidae | + | - | - |
| *Aspidoparia jaya* (Hamilton) | Cyprinidae | + | - | + |
| *Aspidoparia morar* (Hamilton) | Cyprinidae | + | - | - |
| *Badis badis* (Hamilton) | Badidae | + | + | + |
| *Bagarius bagarius* (Hamilton) | Sisoridae | + | + | - |
| *Balitora brucei* Gray | Homalopteridae | - | - | + |
| *Barilius barna* (Hamilton) | Cyprinidae | + | + | + |
| *Barilius bendelesis* (Hamilton) | Cyprinidae | + | + | + |
| *Barilius bola* (Hamilton) | Cyprinidae | + | + | + |
| *Barilius tileo* (Hamilton) | Cyprinidae | + | + | + |
| *Barilius vagra* (Hamilton) | Cyprinidae | + | - | - |
| *Botia dario* Hamilton | Cobitidae | + | + | + |
| *Botia rostrata* Gunther | Cobitidae | + | + | + |
| *Chagunius chagunio* (Hamilton) | Cyprinidae | + | + | + |
| *Parambassis baculis* Hamilton | Chandidae | + | + | - |
| *Chanda nama* (Hamilton) | Chandidae | + | + | + |
| *Parambassis ranga* Hamilton | Chandidae | + | + | + |
| *Channa marulius* (Hamilton) | Channidae | + | - | - |
| *Channa orientalis* Schneider | Channidae | + | + | + |
| *Channa punctatus* (Bloch) | Channidae | + | - | - |
| *Channa striatus* (Bloch) | Channidae | + | - | - |
| *Chela laubuca* (Hamilton) | Cyprinidae | + | - | - |
| *Cirrhinus reba* (Hamilton) | Cyprinidae | + | - | - |
| *Clarias batrachus (*Linnaeus) | Claridae | + | - | + |
| *Crossocheilus latius latius* (Hamilton) | Cyprinidae | + | + | + |
| *Danio aequipinnatus* (McClelland) | Cyprinidae | + | + | + |
| *Danio dangila* (Hamilton) | Cyprinidae | + | - | + |
| *Danio devario* (Hamilton) | Cyprinidae | + | - | + |
| *Brachydanio rerio* (Hamilton) | Cyprinidae | + | + | + |
| *Erethistes pussilus* Muller & Troschel | Erethistidae | + | - | - |
| *Garra annandalei* Hora | Cyprinidae | + | + | + |
| *Garra gotyla gotyla* (Gray) | Cyprinidae | + | + | + |
| *Garra kempi* Hora | Cyprinidae | + | - | - |
| *Garra lissorhynchus* (McClelland) | Cyprinidae | + | - | - |
| *Garra mcclellandi* (Jerdon) | Cyprinidae | + | + | - |
| *Glossogobius giuris* (Hamilton) | Gobiidae | + | - | - |
| *Glyptothorax brevipinnis* Hora | Sisoridae | - | - | + |
| *Glyptothorax cavia* (Hamilton) | Sisoridae | - | - | + |
| *Glyptothorax pectinopterus* (McClelland) | Sisoridae | - | - | + |
| *Glyptothorax telchitta* Hamilton | Sisoridae | - | - | + |
| *Gudusia chapra* (Hamilton) | Clupeidae | + | - | - |
| *Hara hara* (Hamilton) | Erethistidae | + | - | + |
| *Heteropneustes fossilis* (Bloch) | Heteropneustidae | + | - | + |
| *Labeo dero* (Heckel) | Cyprinidae | + | + | + |
| *Labeo pangusia* (Hamilton) | Cyprinidae | + | + | - |
| *Lepidocephalus annandalei* Hora | Cobitidae | + | + | - |
| *Lepidocephalus guntea* (Hamilton) | Cobitidae | + | + | + |

**Table 2**: Comparison of Icthyofauna of three lotic bodies in the district (*contd.*)

| **Species** | **Family** | **Dikrong** | **Pachin** | **Senkhi** |
|---|---|---|---|---|
| *Macrognathus aral* (Bloch & Schneider) | Mastacembelidae | + | - | - |
| *Mastacembelus armatus* (Lacedepe) | Mastacembelidae | + | + | + |
| *Macrognathus pancalus* (Hamilton) | Mastacembelidae | + | - | + |
| *Monopterus cuchia* (Hamilton) | Synbranchidae | + | - | - |
| *Mystus bleekeri* (Day) | Bagridae | + | - | - |
| *Mystus cavasisus* (Hamilton) | Bagridae | + | - | - |
| *Mystus montanus* (Jerdon) | Bagridae | + | - | + |
| *Mystus vittatus* (Bloch) | Bagridae | + | - | - |
| *Nandus nandus* (Hamilton) | Nandidae | + | - | - |
| *Shistura arunachalensis* Dutta & Barman | Cobitidae | + | - | - |
| *Shistura devdevi* Hora | Cobitidae | - | - | + |
| *Shistura sikmaiensis* Hora | Cobitidae | + | - | - |
| *Notopterus notopterus* (Pallas) | Notopteridae | + | - | - |
| *Olyra longicaudata* (McClelland) | Olyridae | + | + | + |
| *Ompok pabda* (Hamilton) | Siluridae | + | - | - |
| *Ompok pabo* (Hamilton) | Siluridae | + | - | - |
| *Pillaia indica* Yazdani | Pillaiidae | + | - | - |
| *Psilorhynchus balitora* (Hamilton) | Psilorhychidae | + | + | + |
| *Puntius chola* (Hamilton) | Cyprinidae | + | + | + |
| *Puntius conchonius* (Hamilton) | Cyprinidae | + | + | + |
| *Puntius sarana sarana* (Hamilton) | Cyprinidae | + | - | - |
| *Puntius sophore* (Hamilton) | Cyprinidae | + | + | - |
| *Puntius ticto* (Hamilton) | Cyprinidae | + | + | + |
| *Rasbora daniconius* (Hamilton) | Cyprinidae | + | - | - |
| *Rasbora elanga* (Hamilton) | Cyprinidae | + | - | - |
| *Rasbora rasbora* (Hamilton) | Cyprinidae | + | - | - |
| *Salmostoma bacaila* (Hamilton) | Cyprinidae | + | - | - |
| *Schizopyge esocinus* (Heckel) | Cyprinidae | - | + | - |
| *Schizothorax richardsonii* (Gray) | Cyprinidae | + | + | - |
| *Semiplotus semiplotus* (McClelland) | Cyprinidae | + | + | + |
| *Silurus afgana* (Gunther) | Siluridae | + | - | - |
| *Somileptes gongota* (Hamilton) | Siluridae | + | - | - |
| *Oreochromis mossambica* (Peters) | Cichlidae | - | - | + |
| *Tor putitora* (Hamilton) | Cyprinidae | + | - | - |
| *Tor tor* (Hamilton) | Cyprinidae | + | + | + |
| *Wallago attu* (Schneider) | Siluridae | + | - | - |
| *Xenentodon cancila* (Hamilton) | Belonidae | + | + | - |
| *Oreicthys cosuatis* (Hamilton) | Cyprinidae | - | - | + |
| *Labeo gonius* (Hamilton) | Cyprinidae | - | - | + |

'+' indicates presence of species; '-' indicates absence of species(s)

distribution of certain families even within the localized sampling area. Species of Mastacembelidae and Olyridae seem restricted to the lower stretches of Senkhi stream as they do not figure in the catches from the study site upstream.

**Table 3**: Total taxa in all three water bodies

| Taxa | Water bodies | | |
|---|---|---|---|
| | Dikrong | Pachin | Senkhi |
| Family | 24 | 11 | 16 |
| Genus | 49 | 25 | 31 |
| Species | 85 | 40 | 47 |

Conversely, representatives from Psilorhynchidae, Homalopteridae, Heteropneustidae, Channidae and Bagridae seem confined to the upper stretches of Senkhi stream Thus, on a higher taxa level, while members of Cyprinidae are the most common and contribute most to the diversity of this lotic system, Psilorhynchidae, Homalopteridae, Heteropneustidae, Channidae and Bagridae appear to be taxonomic groups with both restricted diversity and distribution in this system.

There were in all 95 species (Table 2) in all the three lotic water bodies out of which Dikrong had 85 species

**Table 4**: Total taxa exclusive to Dikrong, Pachin and Senkhi

| Taxa | Water bodies | | |
|---|---|---|---|
| | Dikrong | Pachin | Senkhi |
| Family | 10 | - | 3 |
| Genus | 18 | 1 | 3 |
| Species | 37 | 1 | 9 |

**Table 5**: Total taxa common to Dikrong, Pachin and Senkhi

| Taxa | Water bodies | | |
|---|---|---|---|
| | Dikrong | Pachin | Senkhi |
| Family | 8 | 6 | 9 |
| Genus | 20 | 10 | 8 |
| Species | 29 | 10 | 9 |

(89.47%), followed by Senkhi with 47 species (49.47%) and lastly by Pachin with 41 species (43.16%). There are 29 species under 20 genera and 8 families which were common to all the three lotic bodies and hence can be considered as migratory elements. While there were 47 species which showed exclusive distribution, out of which Dikrong shared the maximum 37 species with 78.72% contribution while Senkhi shared the second slot with 9 species corresponding to 19.15% share while Pachin was far behind in having 1 species with mere 2.13% contribution (Tables 3, 4, 5).

The correlation matrix analysis showed that there is a positive correlation between Dikrong and Pachin at 95% CI, which can be attributed to the taxa having lower altitudinal distribution. While Senkhi and Dikrong showed a negative correlation at 95% CI, which may be due to more of species having adaptation to the high current waters. While the species in the Senkhi stream and Pachin have positive correlation at 95% CI, which is attributed to the migratory nature of the fishes common to these two lotic water bodies. Hence, it can be said that Dikrong and Pachin had more of common elements than Senkhi.

The higher taxa appropriation in all the three lotic water bodies was carried out (Table 6). The striking feature is the absence of the Cichlid family from the lower plain rivers, namely Dikrong and Pachin, it may be mentioned that such cases may be treated as accidental (exotic species) as they may have escaped from nearby culture fishery reservoir. Families like Cyprinidae contribute 45.68% in Dikrong, 27.16% of Pachin and Senkhi respectively and Cobitidae (43.48% in Dikrong, 30.43% in Pachin and 26.09% of Senkhi), which contributes to the largest number of the species in all the three lotic water bodies may be termed as true freshwater Icthyo-families.

**Table 6**: Taxonomic diversity of Icthyofauna in the three lotic systems

| Family | Lotic bodies Dikrong | | Pachin | | Senkhi | |
|---|---|---|---|---|---|---|
| | Gen. | Sp. | Gen. | Sp. | Gen. | Sp. |
| Amblycipitidae | 1 | 3 | 1 | 1 | 1 | 1 |
| Anabantidae | 1 | 1 | - | - | - | - |
| Anguillidae | 1 | 1 | - | - | - | - |
| Badidae | 1 | 1 | 1 | 1 | 1 | 1 |
| Bagridae | 1 | 4 | - | - | 1 | 1 |
| Belonidae | 1 | 1 | 1 | 1 | - | - |
| Chandidae | 1 | 3 | 1 | 3 | 1 | 2 |
| Channidae | 1 | 4 | 1 | 1 | 1 | 1 |
| Cichlidae | - | - | - | - | 1 | 1 |
| Clariidae | 1 | 1 | - | - | 1 | 1 |
| Clupeidae | 1 | 1 | - | - | - | - |
| Cobitidae | 6 | 10 | 4 | 7 | 5 | 6 |
| Cyprinidae | 17 | 37 | 12 | 22 | 12 | 22 |
| Gobiidae | 1 | 1 | - | - | - | - |
| Heteropneustidae | 1 | 1 | - | - | 1 | 1 |
| Homalopteridae | - | - | - | - | 1 | 1 |
| Mastacembelidae | 2 | 3 | 1 | 1 | 1 | 2 |
| Nandidae | 1 | 1 | - | - | - | - |
| Notopteridae | 1 | 1 | - | - | - | - |
| Olyridae | 1 | 1 | 1 | 1 | 1 | 1 |
| Pillaiidae | 1 | 1 | - | - | - | - |
| Psilorhynchidae | 1 | 1 | 1 | 1 | 1 | 1 |
| Siluridae | 3 | 4 | - | - | - | - |
| Sisoridae | 1 | 1 | 1 | 1 | 1 | 4 |
| Synbranchidae | 1 | 1 | - | - | - | - |
| Erethistidae | 2 | 2 | - | - | 1 | 1 |

Gen.: Genus, Sp.: Species

## DISCUSSION

Senkhi, Dikrong and Pachin constitute three contiguous water bodies of Papum Pare district of Arunachal Pradesh. The district harbours one of the most urbanized centres in the State as 15.7% of the people are urban. The anthropogenic pressure coupled with the developmental aspiration of state capital, Itanagar has done more harm to the ambient water bodies. The present enumeration reveals that district holds 59.37% of the state icthyofauna (Jayaram 1964; Nath and Dey 2000; Dutta and Barman 1985; Srivastava 1966; Sen 1999).

Three new reports have been added to the state, namely *Balitora brucei*, *Glyptothorax telchitta* and *Oreochromis mossambica*. It may be worth mentioning that *Oreochromis mossambica* is an exotic species, and hence may be accidental or introduced, such species needs good quarantine as it is known to be a voracious predator. There were 29 species that are common to all the three water bodies, and hence can be termed as migratory elements. Dikrong leads the tally with highest number of exclusive taxa 78.72% (lower floodplain elements) followed by Senkhi 19.15% (hill stream elements).

The comparative study reveals that Dikrong and Pachin have more common species than Senkhi, which is obviously a hill stream. It follows an interesting trend that the Chandidae and Mastacembelidae are also in continuous distribution in the lotic habitat though their species contribution is 8 and 5 respectively. Families like Clupeidae, Notopteridae, Gobiidae and Synbranchidae have distribution only confined to Dikrong, and hence can be treated as lowland riverine families (Das *et al.* 2002). *Balitora brucei* is the only Homalopterid not found in the Dikrong and Pachin. It may be mentioned that this is a true hill stream species. The Sisorids diversity in the hill stream of Senkhi is also a marked feature, which is attributed to adaptative radiation of these catfishes to the high current water (Hora 1922; Tilak 1976; de Pinna 1996). Striking feature is the even distribution of species under families Badidae, Psilorhynchidae and Olyridae, though their contribution to each lotic water body is merely a single species, and hence these species will be most vulnerable once a mega dam comes between restricting the migration of already threatened population.

## REFERENCES


Chaudhuri, B.L. (1913): Zoological results of the abor expedition, 1911-1912 XVIII. *Fish. Rec. Indian Mus. 8*: 243-258.

Das, D.N. (2002): Fish farming in rice environments of North Eastern India. *Aquaculture Asia 7(2)*: 43-47.

Dutta, A.K. & R.P. Barman (1984): On a new species of the genus *Garra* Hamilton (Pisces: Cyprinidae) from Namdapha Wildlife Sanctuary, Arunachal Pradesh, India. *Bull. Zool. Surv. India 6(1-3)*: 283-287.

Dutta, A.K. & R.P. Barman (1985): Fauna of Namdapha, Arunachal Pradesh (Pisces). *Rec. zool. Surv. India 6(1-3)*: 275-277.

Dutta, A.K. & T.K. Sen (1977): *Schizopygopsis stoliczkae* Steindachner - First record from Arunachal Pradesh, India, with observation on geographical range. *Newsl. zool. Surv. India 3(4)*: 143-144.

Hora, S.L. (1921): On some new record and rare species of fishes from Eastern Himalayas. *Rec. Indian Mus. 22(5)*: 731-744.

Hora, S.L. (1922): Structural modifications in the fish of mountain torrents. *Rec. Indian Mus. 24*: 31-61.

Jayaram, K.C. (1963): A new species of Sisorid from Kameng frontier division (NEFA). *J. Zool. Soc. Ind. 15(1)*: 85-87.

Jayaram, K.C. (1999): The Freshwater Fishes of the Indian Region. Narendra Publishing House, Delhi, India. Pp. 551.

Jayaram, K.C. & N. Mazumdar (1964): On a collection of fish from Kameng frontier division, NEFA. *J. Bombay Nat. Hist. Soc. 61(2)*: 264-280.

McClelland, J. (1839): Indian Cyprinidae. *Asiatic Res. 19(2)*: 217-471.

Mittermeier, R.A., N. Myers, R.P. Gil & C.G. Mittermeir (1999): Hotspots: Earth's biologically richest and most endangered terrestrial ecoregions. Cemex, S.A. and Conservation International, Mexico City: Pp. 432.

Myers, N., R.A. Mittermeier, C.G. Mittermeier , G.A.B. da Fonseca & J. Kent (2000): Biodiversity hotspots for conservation priorities. *Nature 403*: 853-858.

Nath, P. & S.C. Dey (2000): Fish and Fisheries of North Eastern India (Arunachal Pradesh). Narendra Publishing House, Delhi. Pp. 161-170.

de Pinna, M.C. (1996): A phylogenetic analysis of the Asian catfish families Sisoridae, Akysidae, and Amblycipitidae, with a hypothesis on the relationships of the neotropical Aspredinidae (Teleostei, Ostariophysi). *Fieldiana: Zoology (New Series) 84*: 1-83.

Sen, T.K. (1985): Fish fauna of Assam and neighbouring North Eastern states of India. *Rec. zool. Surv. India, Occ. Pap. 64*: 1-216.

Sen, N. (1999): On a collection of fishes from Subansiri and Siang districts of Arunachal Pradesh. *Rec. zool. Surv. India 97(1)*: 141-144.

Srivastava, C.B. (1966): On a collection of fishes from Tirap frontier division (NEFA), India. *J. Zool. Soc. India. 18*: 122-128.

Tilak, R. (1976): The adhesive thoracic apparatus in the evolution of glyptothoracoid fishes (Sisoridae: Siluriformes). *Zool. Anz. 196*: 255-261.


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